

**SECTION 18460**  
**DUCTWORK WELDER PERFORMANCE QUALIFICATION TESTS FOR**  
**TARGET BUILDING SYSTEMS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Requirements for the qualification of welders and welding operators on-site in accordance with AWS D-9.1.

**1.2 RELATED SECTIONS**

- A. Section 18100A, General Welding Requirements for Target Building and Beam Dumps Systems.
- B. Section 18410, General Ductwork Welding Requirements.
- C. Section 18450, Ductwork Welding Procedure Specifications.

**PART 2 - PRODUCTS**

**2.1 BASE MATERIAL**

- A. See Section 18100A, General Welding Requirements for Target Building and Beam Dumps Systems.

**2.2 WELDING MATERIALS AND FILLER METALS**

- A. Store, handle, and identify welding electrodes and consumables at all times to avoid material degradation and ensure they are identifiable as acceptable material until the material is actually consumed in the process.

**PART 3 - EXECUTION**

**3.1 TEST REQUIREMENTS**

- A. CM and Contractor welders test to the standard PQTs described in this specification which require the use of WPSs from Section 18450.
- B. PQTs are intended to determine the ability of welders and welding operators to deposit sound welds in accordance with a qualified welding procedure.
- C. Each welder and welding operator must pass a PQT prior to welding on components or assemblies which are fabricated in accordance with the ductwork welding requirements of Section 18100, Paragraph 3.1.
- D. After each welder or welding operator successfully completes the requirements of a test, assign an identification number, letter or symbol to be used to identify work performed by the welder or welding operator. If the welder was previously qualified, use the active identification.
- E. Welders who pass qualification tests for groove welds are qualified to weld on groove welds within the limitations of the test description and for fillet welds of any size on any thickness of material.

### 3.2 RETESTS

- A. A welder who fails to meet requirements of a test may be retested provided there is evidence the welder has had a minimum of 2 hours of additional training or practice. Make a complete retest for the types and positions failed.

### 3.3 RENEWAL OF QUALIFICATION

- A. A welder or welding operator maintains a qualification by welding with the process or by performing a renewal test (update) in accordance with Para. 3.3 B. If not maintained, the qualification is revoked.
- B. The renewal qualification test is required under the following conditions:
  - 1. When the welder or welding operator has not used the welding process (shielded metal arc, gas tungsten arc, etc.) for a period of more than 6 months but less than 1 year.
  - 2. When there are specific reasons to question the welder or welding operator's ability to produce welds that meet the specification requirements.
- C. The renewal test requires the welder to successfully complete one test on the smallest diameter material previously qualified to weld in the most restrictive position using that process. Failure of this test requires the welder to requalify for each performance qualification test needed for that process.
- D. Qualifications expired for longer than a year must complete each performance qualification test needed.
- E. The ability of welders or welding operators to meet specification requirements may be questioned by the test supervisor or his designee at any time.

### 3.4 TEST DESCRIPTION

- A. Each test description defines the requirements to be followed in performance of tests in accordance with the qualified Welding Procedure Specification.
- B. Each test description references the inspection requirements (Paragraph 3.5 A below) required in order to pass the test.
- C. The standard tests qualify only for rectangular duct and round duct 6 in. diam and larger. Qualification for duct less than 6 in. diam requires one of the following supplemental tests:
  - 1. Successful completion of a 2-in. NPS or less pipe test in the 5G or 6G position using the same process per Section 18360.
  - 2. Welding a 2-in. NPS pipe in the 5G position using the same process and testing per Paragraph 3.5 A.
- D. Thickness limits on the PQT are for sheet metal. The test also qualifies for the attachment and joining of any member, regardless of thickness, whose sole purpose is stiffening, supporting, or reinforcing the sheet metal. It also applies to the attachment of accessories or components of the system.

### 3.5 TESTS AND ACCEPTANCE STANDARDS

- A. Inspection:
  - 1. Inspect test welds per Paragraph 4.4 of AWS D-9.1.

- B. Mechanical Testing:
  - 1. Mechanical testing is not required.

**PQT/WPS CROSS REFERENCE (R)**

PQT	WPS	THICKNESS <sup>1</sup>		<u>MIN DIAM</u> <u>OD</u> <sup>2</sup>	COMMENTS
		MIN MATERIAL	MAX DEPOSIT		
SM-1-1	SM11-1(DW)	0.125	0.239	6.000	E6010 Electrode
GT-1-1	GT11-1(DW)	0.062	0.239	6.000	
GT-1-2	GT11-1(DW)	0.0239	0.0956	6.000	
GT-1-3	GT11-2(DW)	0.0258	0.1032	6.000	Galvanized Steel
	GT11-1(DW)	0.0258	0.1032	6.000	
GM-1-1	GM11-1(DW)	0.062	0.125	6.000	
GM-1-2	GM11-1(DW)	0.0239	0.0956	6.000	
GT-8-1	GT88-1(DW)	0.062	0.239	6.000	Purge Required
GT-8-2	GT88-1(DW)	0.0179	0.0718	6.000	Purge Required
GT-8-3	GT88-2(DW)	0.062	0.250	6.000	Flux- Coated Rod
GM-8-1	GM88-1(DW)	0.062	0.125	6.000	Purge Required
GM-8-2	GM88-2(DW)	0.0188	0.075	6.000	Purge Required
GT-23-1	GT23.23-1(DW)	0.062	0.239	6.000	
GT-23-2	GT23.23-1(DW)	0.031	0.125	6.000	
GT-18-1	GT18-1(DW)	0.062	0.239	6.000	
GT-PT-1	GTPT-1(DW)	0.031	0.125	6.000	

<sup>1</sup>See para. 3.4 D.

<sup>2</sup>See para. 3.4 C.

## DUCTWORK WELDING PERFORMANCE QUALIFICATION TEST (PQT)

TEST NUMBER: SM-1-1

REVISION 1

- |    |                               |  |
|----|-------------------------------|--|
| 1. | WELDING PROCESS:              | SMAW (Manual)  |
| 2. | ELECTRODE/FILLER MATERIAL:    | E6010  |
| 3. | BASE MATERIAL:                | Carbon Steel Sheet, 1/8 in. thick X 3 in. wide (min) X 6 in. long (min) without backing (see Section 18470, Fig. B3 for joint detail) and 2-in. NPS, Sch. 80, if required by para. 3.04 C. |
| 4. | WELDING POSITION(S):          | 4G (and 5G if required by para. 3.4 C.)  |
| 5. | VERTICAL WELDING PROGRESSION: | N/A  |
| 6. | WELDING PROCEDURE:            | SM11-1 (DW)  |
| 7. | INSPECTION:                   | See para. 3.5 A.   |
| 8. | TEST(S):                      | N/A  |

### LIMITS OF QUALIFICATION:

- |    |                               |   |
|----|-------------------------------|---|
| 1. | PROCESS:                      | SMAW  |
| 2. | ELECTRODE/FILLER METAL:       | F3 (6010 only)  |
| 3. | BASE MATERIAL:                | P1 and other carbon steels with 0.30% max carbon and 0.50% max chromium |
| 4. | POSITION(S):                  | All   |
| 5. | PIPE GROOVE WELD DIAM LIMITS: | 6-in. OD and larger, see para. 3.4 C.                                   |
| 6. | JOINT TYPES:                  | Groove welds with or without backing or backgouged and fillet welds     |
| 7. | DEPOSITED METAL THICKNESS:    | 0.125 in. through 0.239 in., see para. 3.4 D.                           |
| 8. | PRODUCT FORM:                 | Sheet, plate, and shapes  |

DUCTWORK WELDING PERFORMANCE QUALIFICATION TEST (PQT)

TEST NUMBER: GT-1-1

REVISION 1

- |    |                               |   |
|----|-------------------------------|---|
| 1. | WELDING PROCESS:              | GTAW (Manual)   |
| 2. | ELECTRODE/FILLER MATERIAL:    | ER70S-2 or ER70S-3  |
| 3. | BASE MATERIAL:                | Carbon Steel Sheet, 1/8 in. thick X 3 in. wide (min) X 6 in. long (min) without backing (see Section 18470, Fig. B3 for joint detail) and 2-in. NPS, Sch. 80, if required by para. 3.4 C. |
| 4. | WELDING POSITION(S):          | 4G (and 5G if required by para. 3.4 C.)   |
| 5. | VERTICAL WELDING PROGRESSION: | N/A   |
| 6. | WELDING PROCEDURE:            | GT11-1 (DW), welded without purge   |
| 7. | INSPECTION:                   | See para. 3.5 A.  |
| 8. | TEST(S):                      | N/A   |

LIMITS OF QUALIFICATION:

- |    |                               |   |
|----|-------------------------------|---|
| 1. | PROCESS:                      | GTAW, with or without purge   |
| 2. | ELECTRODE/FILLER METAL:       | F6  |
| 3. | BASE MATERIAL:                | P1 and other carbon steels with 0.30% max carbon and 0.50% max chromium |
| 4. | POSITION(S):                  | All   |
| 5. | PIPE GROOVE WELD DIAM LIMITS: | 6-in. OD and larger, see para. 3.4 C.                                   |
| 6. | JOINT TYPES:                  | Groove welds with or without backing or backgouged and fillet welds     |
| 7. | DEPOSITED METAL THICKNESS:    | 0.062 in. through 0.239 in., see para. 3.4 D.                           |
| 8. | PRODUCT FORM:                 | Sheet, plate, and shapes  |

DUCTWORK WELDING PERFORMANCE QUALIFICATION TEST (PQT)

TEST NUMBER: GT-1-2

REVISION 1

- |    |                               |  |
|----|-------------------------------|--|
| 1. | WELDING PROCESS:              | GTAW (Manual)  |
| 2. | ELECTRODE/FILLER MATERIAL:    | ER70S-2 or ER70S-3   |
| 3. | BASE MATERIAL:                | Carbon Steel Sheet, 0.0478 in. thick (18 gage) X 3 in. wide (min) X 6 in. long (min) without backing (see Section 18470, Fig. GA1 for joint detail) and 2-in. NPS, Sch. 80, if required by para. 3.04 C. |
| 4. | WELDING POSITION(S):          | 4G (and 5G if required by para. 3.4 C.)  |
| 5. | VERTICAL WELDING PROGRESSION: | N/A  |
| 6. | WELDING PROCEDURE:            | GT11-1 (DW), welded without purge  |
| 7. | INSPECTION:                   | See para. 3.5 A.   |
| 8. | TEST(S):                      | N/A  |

LIMITS OF QUALIFICATION:

- |    |                               |   |
|----|-------------------------------|---|
| 1. | PROCESS:                      | GTAW, with or without purge   |
| 2. | ELECTRODE/FILLER METAL:       | F6  |
| 3. | BASE MATERIAL:                | P1 and other carbon steels with 0.30% max carbon and 0.50% max chromium |
| 4. | POSITION(S):                  | All   |
| 5. | PIPE GROOVE WELD DIAM LIMITS: | 6-in. OD and larger, see para. 3.4 C.                                   |
| 6. | JOINT TYPES:                  | Groove welds with or without backing or backgouged and fillet welds     |
| 7. | DEPOSITED METAL THICKNESS:    | 0.0239 in. through 0.0956 in., see para. 3.4 D.                         |
| 8. | PRODUCT FORM:                 | Sheet, plate, and shapes  |

DUCTWORK WELDING PERFORMANCE QUALIFICATION TEST (PQT)

TEST NUMBER: GT-1-3

REVISION 1

- |    |                               |  |
|----|-------------------------------|--|
| 1. | WELDING PROCESS:              | GTAW (Manual)  |
| 2. | ELECTRODE/FILLER MATERIAL:    | ER70S-2 or ER70S-3   |
| 3. | BASE MATERIAL:                | Galvanized Steel Sheet, 0.0516 in. thick (18 gage)<br>X 3 in. wide (min) X 6 in. long (min) without<br>backing (see Section 18470, Fig. GA1 for joint<br>detail) and 2-in. NPS, Sch. 80, if required by<br>para. 3.4 C |
| 4. | WELDING POSITION(S):          | 4G (and 5G if required by para. 3.4 C.)  |
| 5. | VERTICAL WELDING PROGRESSION: | N/A  |
| 6. | WELDING PROCEDURE:            | GT11-2 (DW), welded without purge  |
| 7. | INSPECTION:                   | See para. 3.5 A.   |
| 8. | TEST(S):                      | N/A  |

LIMITS OF QUALIFICATION:

- |    |                               |  |
|----|-------------------------------|--|
| 1. | PROCESS:                      | GTAW, with or without purge  |
| 2. | ELECTRODE/FILLER METAL:       | F6   |
| 3. | BASE MATERIAL:                | P1 and other carbon steels with 0.30% max<br>carbon and 0.50% max chromium |
| 4. | POSITION(S):                  | All  |
| 5. | PIPE GROOVE WELD DIAM LIMITS: | 6-in. OD and larger, see para. 3.4 C.                                      |
| 6. | JOINT TYPES:                  | Groove welds with or without backing or<br>backgouged and fillet welds     |
| 7. | DEPOSITED METAL THICKNESS:    | 0.0258 in. through 0.1032 in., see para. 3.4 D.                            |
| 8. | PRODUCT FORM:                 | Sheet, plate, and shapes   |



## DUCTWORK WELDING PERFORMANCE QUALIFICATION TEST (PQT)

TEST NUMBER: GM-1-1

REVISION 0

- |    |                               |   |
|----|-------------------------------|---|
| 1. | WELDING PROCESS:              | GMAW (Semiautomatic)  |
| 2. | ELECTRODE/FILLER MATERIAL:    | ER70S-2 or ER70S-3  |
| 3. | BASE MATERIAL:                | Carbon Steel Sheet, 1/8 in. thick X 3 in. wide (min) X 6 in. long (min) without backing (see Section 18470, Fig. B3 for joint detail) and 2-in. NPS, Sch. 80, if required by para. 3.4 C. |
| 4. | WELDING POSITION(S):          | 4G (and 5G if required by para. 3.4 C.)   |
| 5. | VERTICAL WELDING PROGRESSION: | N/A   |
| 6. | WELDING PROCEDURE:            | GM11-1 (DW), welded without purge   |
| 7. | INSPECTION:                   | See para. 3.5 A.  |
| 8. | TEST(S):                      | N/A   |

### LIMITS OF QUALIFICATION:

- |    |                               |   |
|----|-------------------------------|---|
| 1. | PROCESS:                      | GMAW, with or without purge   |
| 2. | ELECTRODE/FILLER METAL:       | F6  |
| 3. | BASE MATERIAL:                | P1 and other carbon steels with 0.30% max carbon and 0.50% max chromium |
| 4. | POSITION(S):                  | All   |
| 5. | PIPE GROOVE WELD DIAM LIMITS: | 6-in. OD and larger, see para. 3.4 C.                                   |
| 6. | JOINT TYPES:                  | Groove welds with or without backing or backgouged and fillet welds     |
| 7. | DEPOSITED METAL THICKNESS:    | 0.062 in. through 0.125 in., see para. 3.4 D.                           |
| 8. | PRODUCT FORM:                 | Sheet, plate, and shapes  |

DUCTWORK WELDING PERFORMANCE QUALIFICATION TEST (PQT)

TEST NUMBER: GM-1-2

REVISION 0

- |    |                               |   |
|----|-------------------------------|---|
| 1. | WELDING PROCESS:              | GMAW (Semiautomatic)  |
| 2. | ELECTRODE/FILLER MATERIAL:    | ER70S-2 or ER70S-3  |
| 3. | BASE MATERIAL:                | Carbon Steel Sheet, 0.0478 in. thick (18 gage) X 3 in. wide (min) X 6 in. long (min) without backing (see Section 18470, Fig. GA1 for joint detail) and 2-in. NPS, Sch. 80, if required by para. 3.4 C. |
| 4. | WELDING POSITION(S):          | 4G (and 5G if required by para. 3.4 C.)   |
| 5. | VERTICAL WELDING PROGRESSION: | N/A   |
| 6. | WELDING PROCEDURE:            | GM11-1 (DW), welded without purge   |
| 7. | INSPECTION:                   | See para. 3.5 A.  |
| 8. | TEST(S):                      | N/A   |

LIMITS OF QUALIFICATION:

- |    |                               |   |
|----|-------------------------------|---|
| 1. | PROCESS:                      | GMAW, with or without purge   |
| 2. | ELECTRODE/FILLER METAL:       | F6  |
| 3. | BASE MATERIAL:                | P1 and other carbon steels with 0.30% max carbon and 0.50% max chromium |
| 4. | POSITION(S):                  | All   |
| 5. | PIPE GROOVE WELD DIAM LIMITS: | 6-in. OD and larger, see para. 3.4 C.                                   |
| 6. | JOINT TYPES:                  | Groove welds with or without backing or backgouged and fillet welds     |
| 7. | DEPOSITED METAL THICKNESS:    | 0.0239 in. through 0.0956 in., see para. 3.4 D.                         |
| 8. | PRODUCT FORM:                 | Sheet, plate, and shapes  |

## DUCTWORK WELDING PERFORMANCE QUALIFICATION TEST (PQT)

TEST NUMBER: GT-8-1

REVISION 2

- |    |                               |  |
|----|-------------------------------|--|
| 1. | WELDING PROCESS:              | GTAW (Manual)  |
| 2. | ELECTRODE/FILLER MATERIAL:    | ER308 or ER308L  |
| 3. | BASE MATERIAL:                | Stainless Steel Sheet, 1/8 in. thick X 3 in. wide (min) X 6 in. long (min) without backing (see Section 18470, Fig. B3 for joint detail) and 2-in. NPS, Sch. 80, if required by para. 3.4 C. |
| 4. | WELDING POSITION(S):          | 4G (and 5G if required by para. 3.4 C.)  |
| 5. | VERTICAL WELDING PROGRESSION: | N/A  |
| 6. | WELDING PROCEDURE:            | GT88-1 (DW), welded with purge   |
| 7. | INSPECTION:                   | See para. 3.5 A.   |
| 8. | TEST(S):                      | N/A  |

### LIMITS OF QUALIFICATION:

- |    |                               |   |
|----|-------------------------------|---|
| 1. | PROCESS:                      | GTAW, with purge  |
| 2. | ELECTRODE/FILLER METAL:       | F6  |
| 3. | BASE MATERIAL:                | P8 and other austenitic stainless steels with similar composition   |
| 4. | POSITION(S):                  | All   |
| 5. | PIPE GROOVE WELD DIAM LIMITS: | 6-in. OD and larger, see para. 3.4 C.                               |
| 6. | JOINT TYPES:                  | Groove welds with or without backing or backgouged and fillet welds |
| 7. | DEPOSITED METAL THICKNESS:    | 0.062 in. through 0.239 in., see para. 3.4 D.                       |
| 8. | PRODUCT FORM:                 | Sheet, plate, and shapes  |

## DUCTWORK WELDING PERFORMANCE QUALIFICATION TEST (PQT)

TEST NUMBER: GT-8-2

REVISION 1

- |    |                               |  |
|----|-------------------------------|--|
| 1. | WELDING PROCESS:              | GTAW (Manual)  |
| 2. | ELECTRODE/FILLER MATERIAL:    | ER308 or ER308L  |
| 3. | BASE MATERIAL:                | Stainless Steel Sheet, 0.0359 in. thick (20 gage) X 3 in. wide (min) X 6 in. long (min) without backing (see Section 18470, Fig. GA1 for joint detail) and 2-in. NPS, Sch. 80, if required by para. 3.4 C. |
| 4. | WELDING POSITION(S):          | 4G (and 5G if required by para. 3.4 C.)  |
| 5. | VERTICAL WELDING PROGRESSION: | N/A  |
| 6. | WELDING PROCEDURE:            | GT88-1 (DW), welded with purge   |
| 7. | INSPECTION:                   | See para. 3.5 A.   |
| 8. | TEST(S):                      | N/A  |

### LIMITS OF QUALIFICATION:

- |    |                               |   |
|----|-------------------------------|---|
| 1. | PROCESS:                      | GTAW, with purge  |
| 2. | ELECTRODE/FILLER METAL:       | F6  |
| 3. | BASE MATERIAL:                | P8 and other austenitic stainless steels with similar composition   |
| 4. | POSITION(S):                  | All   |
| 5. | PIPE GROOVE WELD DIAM LIMITS: | 6-in. OD and larger, see para. 3.4 C.                               |
| 6. | JOINT TYPES:                  | Groove welds with or without backing or backgouged and fillet welds |
| 7. | DEPOSITED METAL THICKNESS:    | 0.0239 in. through 0.0956 in., see para. 3.4 D.                     |
| 8. | PRODUCT FORM:                 | Sheet, plate, and shapes  |

## DUCTWORK WELDING PERFORMANCE QUALIFICATION TEST (PQT)

TEST NUMBER: GT-8-3

REVISION 1

- |                                  |   |
|----------------------------------|---|
| 1. WELDING PROCESS:              | GTAW (Manual)   |
| 2. ELECTRODE/FILLER MATERIAL:    | ER308LFC (Flux-Coated Filler Wire<br>Manufactured by Filler Metals Inc.)  |
| 3. BASE MATERIAL:                | Stainless Steel Sheet, 1/8 in. thick X 3 in. wide<br>(min) X 6 in. long (min) without backing (see<br>Section 18470, Fig. B3 for joint detail) and 2-in.<br>NPS, Sch. 80, if required by para. 3.4 C. |
| 4. WELDING POSITION(S):          | 4G (and 5G if required by para. 3.4 C.)   |
| 5. VERTICAL WELDING PROGRESSION: | N/A   |
| 6. WELDING PROCEDURE:            | GT88-2 (DW), welded without purge   |
| 7. INSPECTION:                   | See para. 3.5 A.  |
| 8. TEST(S):                      | N/A   |

### LIMITS OF QUALIFICATION:

- |                                  |   |
|----------------------------------|---|
| 1. PROCESS:                      | GTAW, without purge                           |
| 2. ELECTRODE/FILLER METAL:       | F6  |
| 3. BASE MATERIAL:                | Type 304 and 304L stainless steels            |
| 4. POSITION(S):                  | All   |
| 5. PIPE GROOVE WELD DIAM LIMITS: | 6-in. OD and larger, see para. 3.4 C.         |
| 6. JOINT TYPES:                  | Groove welds with or without backing          |
| 7. DEPOSITED METAL THICKNESS:    | 0.062 in. through 0.239 in., see para. 3.4 D. |
| 8. PRODUCT FORM:                 | Sheet, plate, and shapes                      |

DUCTWORK WELDING PERFORMANCE QUALIFICATION TEST (PQT)

TEST NUMBER: GM-8-1

REVISION 1

- |    |                               |  |
|----|-------------------------------|--|
| 1. | WELDING PROCESS:              | GMAW (Semiautomatic)   |
| 2. | ELECTRODE/FILLER MATERIAL:    | ER308 or ER308L  |
| 3. | BASE MATERIAL:                | Stainless Steel Sheet, 1/8 in. thick X 3 in. wide (min) X 6 in. long (min) without backing (see Section 18470, Fig. B3 for joint detail) and 2-in. NPS, Sch. 80, if required by para. 3.4 C. |
| 4. | WELDING POSITION(S):          | 4G (and 5G if required by para. 3.4 C.)  |
| 5. | VERTICAL WELDING PROGRESSION: | N/A  |
| 6. | WELDING PROCEDURE:            | GM88-1 (DW), welded with purge   |
| 7. | INSPECTION:                   | See para. 3.5 A.   |
| 8. | TEST(S):                      | N/A  |

LIMITS OF QUALIFICATION:

- |    |                               |   |
|----|-------------------------------|---|
| 1. | PROCESS:                      | GMAW, with purge  |
| 2. | ELECTRODE/FILLER METAL:       | F6  |
| 3. | BASE MATERIAL:                | P8 and other austenitic stainless steels with similar composition   |
| 4. | POSITION(S):                  | All   |
| 5. | PIPE GROOVE WELD DIAM LIMITS: | 6-in. OD and larger, see para. 3.4 C.                               |
| 6. | JOINT TYPES:                  | Groove welds with or without backing or backgouged and fillet welds |
| 7. | DEPOSITED METAL THICKNESS:    | 0.062 in. through 0.125 in., see para. 3.4 D.                       |
| 8. | PRODUCT FORM:                 | Sheet, plate, and shapes  |

## DUCTWORK WELDING PERFORMANCE QUALIFICATION TEST (PQT)

TEST NUMBER: GM-8-2

REVISION 1

- |    |                               |   |
|----|-------------------------------|---|
| 1. | WELDING PROCESS:              | GMAW (Semiautomatic)  |
| 2. | ELECTRODE/FILLER MATERIAL:    | ER308 or ER308L   |
| 3. | BASE MATERIAL:                | Stainless Steel Sheet, 0.0375 in. thick (20 gage) X 3 in. wide (min) X 6 in. long (min) without backing (see Section 18470, Fig. B3 for joint detail) and 2-in. NPS, Sch. 80, if required by para. 3.4 C. |
| 4. | WELDING POSITION(S):          | 4G (and 5G if required by para. 3.4 C.)   |
| 5. | VERTICAL WELDING PROGRESSION: | N/A   |
| 6. | WELDING PROCEDURE:            | GM88-1 (DW), welded with purge  |
| 7. | INSPECTION:                   | See para. 3.5 A.  |
| 8. | TEST(S):                      | N/A   |

### LIMITS OF QUALIFICATION:

- |    |                               |   |
|----|-------------------------------|---|
| 1. | PROCESS:                      | GMAW, with purge  |
| 2. | ELECTRODE/FILLER METAL:       | F6  |
| 3. | BASE MATERIAL:                | P8 and other austenitic stainless steels with similar composition   |
| 4. | POSITION(S):                  | All   |
| 5. | PIPE GROOVE WELD DIAM LIMITS: | 6-in. OD and larger, see para. 3.4 C.                               |
| 6. | JOINT TYPES:                  | Groove welds with or without backing or backgouged and fillet welds |
| 7. | DEPOSITED METAL THICKNESS:    | 0.0188 in. through 0.075 in., see para. 3.4 D.                      |
| 8. | PRODUCT FORM:                 | Sheet, plate, and shapes  |

DUCTWORK WELDING PERFORMANCE QUALIFICATION TEST (PQT)

TEST NUMBER: GT-23-1

REVISION 2

- |    |                               |  |
|----|-------------------------------|--|
| 1. | WELDING PROCESS:              | GTAW (Manual), ACHF  |
| 2. | ELECTRODE/FILLER MATERIAL:    | ER4043   |
| 3. | BASE MATERIAL:                | Aluminum Sheet, 1/8 in. thick X 3 in. wide (min)<br>X 6 in. long (min) without backing (see<br>Section 18470, Fig. B3 for joint detail) and 2-in.<br>NPS, Sch. 80, if required by para. 3.4 C. |
| 4. | WELDING POSITION(S):          | 4G (and 5G if required by para. 3.4 C.)  |
| 5. | VERTICAL WELDING PROGRESSION: | N/A  |
| 6. | WELDING PROCEDURE:            | GT23.23-1 (DW), welded without purge   |
| 7. | INSPECTION:                   | See para. 3.5 A.   |
| 8. | TEST(S):                      | N/A  |

LIMITS OF QUALIFICATION:

- |    |                               |  |
|----|-------------------------------|--|
| 1. | PROCESS:                      | GTAW, ACHF, with or without purge                                      |
| 2. | ELECTRODE/FILLER METAL:       | F23  |
| 3. | BASE MATERIAL:                | P21 through P25 or other aluminum alloys with<br>similar composition   |
| 4. | POSITION(S):                  | All  |
| 5. | PIPE GROOVE WELD DIAM LIMITS: | 6-in. OD and larger, see para. 3.4 C.                                  |
| 6. | JOINT TYPES:                  | Groove welds with or without backing or<br>backgouged and fillet welds |
| 7. | DEPOSITED METAL THICKNESS:    | 0.062 in. through 0.239 in., see para. 3.4 D.                          |
| 8. | PRODUCT FORM:                 | Sheet, plate, and shapes   |



## DUCTWORK WELDING PERFORMANCE QUALIFICATION TEST (PQT)

TEST NUMBER: GT-23-2

REVISION 1

- |    |                               |   |
|----|-------------------------------|---|
| 1. | WELDING PROCESS:              | GTAW (Manual), ACHF   |
| 2. | ELECTRODE/FILLER MATERIAL:    | ER4043  |
| 3. | BASE MATERIAL:                | Aluminum Sheet, 0.0625 in. thick X 3 in. wide (min) X 6 in. long (min) without backing (see Section 18470, Fig. GA1 for joint detail) and 2-in. NPS, Sch. 80, if required by para. 3.4 C. |
| 4. | WELDING POSITION(S):          | 4G (and 5G if required by para. 3.4 C.)   |
| 5. | VERTICAL WELDING PROGRESSION: | N/A   |
| 6. | WELDING PROCEDURE:            | GT23.23-1 (DW), welded without purge  |
| 7. | INSPECTION:                   | See para. 3.5 A.  |
| 8. | TEST(S):                      | N/A   |

### LIMITS OF QUALIFICATION:

- |    |                               |   |
|----|-------------------------------|---|
| 1. | PROCESS:                      | GTAW, ACHF, with or without purge                                   |
| 2. | ELECTRODE/FILLER METAL:       | F23   |
| 3. | BASE MATERIAL:                | P21 through P25 or other aluminum alloys with similar composition   |
| 4. | POSITION(S):                  | All   |
| 5. | PIPE GROOVE WELD DIAM LIMITS: | 6-in. OD and larger, see para. 3.4 C.                               |
| 6. | JOINT TYPES:                  | Groove welds with or without backing or backgouged and fillet welds |
| 7. | DEPOSITED METAL THICKNESS:    | 0.031 in. through 0.125 in., see para. 3.4 D.                       |
| 8. | PRODUCT FORM:                 | Sheet, plate, and shapes  |

DUCTWORK WELDING PERFORMANCE QUALIFICATION TEST (PQT)

TEST NUMBER: GT-18-1

REVISION 1

- |    |                               |  |
|----|-------------------------------|--|
| 1. | WELDING PROCESS:              | GTAW (Manual)  |
| 2. | ELECTRODE/FILLER MATERIAL:    | ER309 or ER309L  |
| 3. | BASE MATERIAL:                | Carbon Steel Sheet to Stainless Steel Sheet, 1/8 in. thick X 3 in. wide (min) X 6 in. long (min) without backing (see Section 18470, Fig. B3 for joint detail) and 2-in. NPS, Sch. 80, if required by para. 3.4 C. |
| 4. | WELDING POSITION(S):          | 4G (and 5G if required by para. 3.4 C.)  |
| 5. | VERTICAL WELDING PROGRESSION: | N/A  |
| 6. | WELDING PROCEDURE:            | GT18-1 (DW), welded with purge   |
| 7. | INSPECTION:                   | See para. 3.5 A.   |
| 8. | TEST(S):                      | N/A  |

LIMITS OF QUALIFICATION:

- |    |                               |   |
|----|-------------------------------|---|
| 1. | PROCESS:                      | GTAW with purge   |
| 2. | ELECTRODE/FILLER METAL:       | F6  |
| 3. | BASE MATERIAL:                | P1 and other carbon steels with 0.30% max carbon and 0.50% max chromium to P8 or other austenitic stainless steels with similar composition |
| 4. | POSITION(S):                  | All   |
| 5. | PIPE GROOVE WELD DIAM LIMITS: | 6-in. OD and larger, see para. 3.4 C.   |
| 6. | JOINT TYPES:                  | Groove welds with or without backing or backgouged and fillet welds   |
| 7. | DEPOSITED METAL THICKNESS:    | 0.062 in. through 0.239 in., see para. 3.4 D.   |
| 8. | PRODUCT FORM:                 | Sheet, plate, and shapes  |

DUCTWORK WELDING PERFORMANCE QUALIFICATION TEST (PQT) (N)

TEST NUMBER: GT-PT-1

REVISION 0

- |    |                               |   |
|----|-------------------------------|---|
| 1. | WELDING PROCESS:              | GTAW (Manual)   |
| 2. | ELECTRODE/FILLER MATERIAL:    | Platinum material   |
| 3. | BASE MATERIAL:                | Platinum Sheet, 1/8 in. thick X 3 in. wide (min) X 6 in. long (min) without backing (see Section 18470, Fig. B3 for joint detail) and 2-in. NPS, Sch. 80, if required by para. 3.4 C. Two corners of Platinum boats from 9212 may be substituted. |
| 4. | WELDING POSITION(S):          | 3G  |
| 5. | VERTICAL WELDING PROGRESSION: | Uphill  |
| 6. | WELDING PROCEDURE:            | GTPT-1 (DW), welded without purge   |
| 7. | INSPECTION:                   | See para. 3.5 A.  |
| 8. | TEST(S):                      | N/A   |

LIMITS OF QUALIFICATION:

- |    |                               |   |
|----|-------------------------------|---|
| 1. | PROCESS:                      | GTAW, with or without purge   |
| 2. | ELECTRODE/FILLER METAL:       | 1/8 in. wide strips of Platinum                                     |
| 3. | BASE MATERIAL:                | Platinum  |
| 4. | POSITION(S):                  | Flat, horizontal, vertical upwards                                  |
| 5. | PIPE GROOVE WELD DIAM LIMITS: | 6-in. OD and larger, see para. 3.4 C.                               |
| 6. | JOINT TYPES:                  | Groove welds with or without backing or backgouged and fillet welds |
| 7. | DEPOSITED METAL THICKNESS:    | 0.031 in. through 0.125 in., see para. 3.4 D.                       |
| 8. | PRODUCT FORM:                 | Sheet, plate, and shapes  |

**END OF SECTION 18460**